

AC 2010-1145: HERMANAS: DISEÑA TU FUTURO: INTEL CORPORATION AND ESTRELLA MOUNTAIN COMMUNITY COLLEGE PARTNER TO INCREASE LATINAS IN STEM

Arlisa Labrie Richardson, Estrella Mountain Community College

Arlisa Richardson earned her Bachelor of Science in Physics from Grambling State University, a Masters of Science in Physics from the University of Texas at Dallas, and a Masters of Science in Engineering of Materials from Arizona State University. In 2008, she completed a Ph.D. in Curriculum and Instruction specializing in Science Education at Arizona State University. Her research focused on the development of students' tinkering self-efficacy during a freshman engineering design course; specifically examining the impact of team interactions and gender.

Arlisa's research interest includes issues of engineering recruitment, retention, and equity in science, engineering and technology, which stems from her personal academic and professional experience as an engineer. Before returning to graduate school to pursue a Doctorate degree, she worked as an engineer in the semiconductor manufacturing industry for ten years. In her current position, Director of Learning Support Services at Estrella Mountain Community College (EMCC) in Avondale, AZ, she utilizes her academic and professional background to prepare students for successful careers in the science, technology, engineering and mathematics (STEM) fields.

Maria Reyes, Estrella Mountain Community College

Maria Reyes is the Associate Dean for Occupational Education at Estrella Mountain Community College (Estrella Mountain). She established and served as the Director of the NASA Center for Success in Math & Science at Estrella Mountain, funded by NASA. In addition, she was the Title V: Hispanic Serving Institution Department of Education Grant Director at Estrella Mountain from 2001 – 2006. She also works with the Engineering Pathways Taskforce for the AZ STEM Initiative, a statewide effort to bring STEM programs to underserved areas and expand outreach. In 2009, Maria was the Chairwoman for Hispanic Women's Conference, the largest national conference for Latina professionals.

Maria has worked in higher education for sixteen years. Her areas of expertise include recruitment and retention of underrepresented populations in Science, Technology, Engineering & Mathematics (STEM) throughout the educational pathway K-20, transition for students from high school to community college to university in STEM career areas, community-based engineering design conferences for recruitment and retention of women in engineering, mentoring and leadership programs for women of color in STEM, and outreach STEM programs. Maria is an engineer with a Bachelors and Masters in Civil Engineering from Arizona State University. She is a past fellow from the National Hispana Leadership Institute. Each year only 20 women are selected from across the nation to participate in this fellowship experience which includes leadership development programs at Harvard's John F. Kennedy School of Government and the Center for Creative Leadership, two of the top ranked leadership development programs in the country. In addition, Maria completed a Masters in Public Administration from Harvard University, Kennedy School of Government.

Marge Goodman, Intel Corporation

Hermanas: Diseña Tu Futuro

Intel Corporation and Estrella Mountain Community College partner to increase Latinas in STEM

Introduction

Traditionally, minorities and women have comprised a low percentage in the fields of science, mathematics, engineering and technology. Even more alarming is the fact that Latinas are more likely than girls of any other ethnic group to drop out of high school, further decreasing their likelihood of attending college and pursuing careers in these fields. According to the National Science Foundation, only 20% of the engineering bachelor degrees earned in 2002 went to women. In 2002, only 6% of the engineering degrees were earned by Hispanic students. These figures have basically remained steady since 1995.

In an effort to address the growing issue of under-representation of Latinas in science, technology, engineering and mathematics (STEM), Estrella Mountain Community College and Intel Corporation collaborated to host a conference specifically aimed at closing the gender and diversity gap in the STEM fields. Estrella Mountain, a Hispanic Serving Institution (HSI), partnered with Intel to plan and design the Hermanas: Diseña Tu Futuro conference. Intel Corporation collaborates with educators in communities around the Valley to improve the quality of STEM education by providing commitments of time, programs and resources to help students realize their full potential.

Hosted by Estrella Mountain, the Hermanas conference has hosted over 900 Latinas from Central Phoenix and West Valley middle and high schools. The free one-day conference exposes participants to professional and personal development workshops and hands-on science activities conducted by a diverse group of Intel engineers, scientists and technologists. In addition, the conference provides a supportive environment where young women have the opportunity to interact with successful Latinas, explore technical careers and receive encouragement to finish school, attend college and pursue their educational and personal goals. Participants also focus on developing problem solving skills, teamwork and creativity through a series of interactive, hands-on workshops.¹

Estrella Mountain Community College

Estrella Mountain Community College (Estrella Mountain) is one of the ten Maricopa County Community Colleges in the Phoenix area of Arizona. Estrella Mountain serves approximately 14,000+ annual enrollment which is a 21% increase over the last five years. The college's growing student body is comprised of 29% full-time (71% part-time) students with more than 64% of the students fewer than 24 years of age. Many of the students are first generation, academically at risk and/or financially needy. Estrella Mountain is a Hispanic Serving Institution (HSI) as designated by the US Department of Education Title V – Strengthening

Hispanic Serving Institutions grants. Estrella Mountain reached this designation in 2001 with a Hispanic student population of 31 % and currently serves a Hispanic population of 34%.

Intel Corporation

Intel Corporation is not only a world technology leader but also a good corporate citizen who strives to create positive relationships with the community where Intel operates. One of Intel's focuses is to contribute to important social issues or communities to enhance and prepare youth for their futures in the science and technology fields.

The Intel Latino Employee Support Group and the Latina Women's Outreach team's desire to make a focused and direct impact on the community youth by providing interaction with professional Latina women in the science and technology fields, provide the guidance and influence to help students define their future career choices, and exposure to the sciences to local community students to close the gender gap in the

The conference is sponsored by Intel through the Intel Foundation Volunteer Matching Grant Program (VMGP). The volunteer hours that the Intel employees put forth in support of the conference design, planning and implementation are cataloged by the Intel team members and submitted to the VMGP office for support of the upcoming conferences each year. This funding is typically \$15,000 annually. Throughout the six years, the conference has also received smaller supportive grants from IBM (\$500 annually), Avnet (in-kind donations of refurbished laptop computers), Qwest Foundation (one time donation of \$7,500) and Latino Perspectives Magazine (in-kind support through publication of Conference recognition). In addition, the conference success relies strongly on the Estrella Mountain administration and campus commitment to these outreach effort as the combined staff time and human resource support through multiple institutional areas are critical.

Research on gender gap in STEM

The National Council for Research on Women in a 2001 report acknowledges that as a result of the overall effort of recent decades to improve STEM education, the gender gap in science and math achievement has narrowed significantly. However, studies still reveal that there are weaknesses in the training of girls. For example, young women have less confidence in their math skills than young men. High school boys still outperform girls at higher levels of math achievement. Innovative programs for girls and young women provide opportunities for them to interact with women in science, work with the latest technology and equipment and in some cases meet the needs of young African American women and Latinas who are in danger of being left behind.²

For the most part girls and young women successful complete high school math and science, but retention of potential female scientists and engineers becomes more complex at the undergraduate level. For the young women who decide to study in STEM fields in college

usually have career goals that are not as well defined as their male peers. During the first year of undergraduate studies women disproportionately abandon plans to major in the STEM fields. Their retention rates grow as they become more comfortable and confident in their skills.²

According to data from the American Society for Engineering Education, in 2004 women earned just over 20 percent of the bachelor's degrees in engineering. This number has not changed in the past five years. There are numerous research studies that attempt to uncover the reason there are so few women in science, engineering and technology. The ongoing inquiry to understand the conditions that lead to young women choosing to pursue a career in science, engineering or technology, and the persistence and loss of women in these fields has resulted in some understanding of why so few women enter and or persist in the STEM fields.

These studies have shown that women's experiences in engineering, in school as well as the workplace, were often negative. Henes, Bland, Darby, and McDonald (1995), reported the results of a University of California Davis survey of 419 male and female engineering students indicated five major reasons why women leave or become discouraged with engineering: (1) Isolation (2) Not seeing relevance of highly theoretical basic courses (3) Negative experiences in laboratory courses (4) The "cold classroom climate" and (5) Lack of role models.³

Self-efficacy theory and Best Practices

The Hermanas Conference is a professional one-day conference that includes hands-on workshops, guest speakers, interaction with college faculty and staff, education information sessions, conference bags and door prizes. Bandura's theory of self efficacy provided the theoretical foundation of the Hermanas conference, which was designed to not only inform participants about to careers in the STEM field but to address many of the reasons women don't pursue STEM career. In addition, the best practices for STEM outreach were utilized as a guide for designing the conference.

Self-efficacy theory is concerned with an individual's beliefs about their personal capabilities to organize and execute a course of action to accomplish designated goals or performances. Self efficacy beliefs touch almost every aspect of a person's life based on whether they think productively, pessimistically or optimistically; how well they are capable of self-motivation and persevering in the face of adversities; their vulnerability to stress and depression and the life choices they make. A person's perceived self-efficacy will determine their behavior towards endeavors. There are four sources that aid in the development and modification of a person's self-efficacy beliefs. The sources are listed as follows from most influential to least influential: (1) performance accomplishment, (2) vicarious experiences, (3) verbal persuasion or encouragement from others, and (4) physiological or emotional arousal (i.e. anxiety).^{5,6}

In 2001, Estrella Mountain hosted a National Science Foundation sponsored symposium on best practices for student achievement including research by faculty members that resulted in the publication: A Summary of the National Symposium on Best Practices for Student Achievement

in Two-Year Hispanic Serving Institutions which highlighted the special needs of the growing number of Hispanic students and made recommendations for the National Science Foundation and two-year colleges that serve Hispanic students nationwide. This publication was followed up with a subsequent publication entitled: Community College Best Practices highlighting best practices for student achievement in STEM at two-year Hispanic Serving Institutions.^{15, 16}

The publications note the importance of “reaching out to the earliest grades, not just high school” to provide a seamless transition for students in STEM career areas. They also highlight the importance of involving families and communities in all stages of education even going as far as to recommend that “ambassadors” speak to families and community groups about the opportunities in the STEM career areas in general and “programs at local community colleges in particular”.¹⁵ One of the highlighted best practices is to “create bridges to K-12 institutions” which includes ongoing communication, coordination of STEM curriculum and opportunities for elementary school students to visit community college campuses. Early and often exposure to the community college campus improves the probability that the student will chose to attend that college at the appropriate time.

Some of the Best Practices in STEM Outreach which are applicable to the Hermanas Conference are listed below.¹⁵

- Expose students and their families to the campus community early and often
- Develop strong links to K-12 Institutions
- “Blur the Line” between High School and College
- Holistic Approach to the Student, Family & Community – involve parents and family in the educational process
- Support On-going Mentoring and Network for Students
- Teacher Participation and professional development

Hermanas Conference

The Hermanas conference provides participants with positive experiences and role models in STEM, resources for academic success and vicarious experiences that simulate engineering or design work in a team environment. The following paragraphs provide an overview of the conference components and how each component addresses building self-efficacy and utilizing the STEM best practices outlined in the previous section.

A key component of the Hermanas conference is the informal hands-on workshops, which are facilitated by college faculty and designed to expose participants to teamwork and the engineering design process. The workshops provide an opportunity to “tinker” with tools and materials. Activities are selected based on the timeframe allotted and ease of accomplishment yet

challenging. The last few years of the conference activities were also chosen based on the theme of alternative energy. The most influential source of strengthening self-efficacy is through mastery experiences, also referred to as performance accomplishments. Successful experiences strengthen one's self-efficacy in a given area. The hands-on activities provide participants with a chance to build self-efficacy by successfully completing a task that is related to engineering design.

The Latina Town Hall provides the student participants with an opportunity to see others like themselves succeeding in a STEM career. The students also have an opportunity to interact with Latinas who are currently studying or working in the STEM fields. This component of the conference provides the second most influential source of self-efficacy, which is vicarious learning or modeling. Observing someone similar to oneself succeeding at a given behavior or task through sustained effort will increase the observer's self-efficacy. The greater the observer perceives a similarity with the observed the more persuasive the observation.³

The small group lunch and discussions were designed specifically to establish a relationship between participants and volunteer college faculty by creating opportunities to talk with college faculty and staff member on a more informal and personal level. Verbal persuasion is the third way to influence self-efficacy beliefs. Encouragement and verbal support from others will increase one's effort and persistence to accomplish a task.³ During the Hermanas conference there are several opportunities for participants to experience verbal encouragement, however the lunch discussions are specifically targeted to engage in encouraging conversations. In addition, the small group lunch offers an opportunity to minimize any anxiety participants may have about going to college or being on a college campus. This is not only a potential source of building self-efficacy toward going to college but also addresses the best practice of exposing students and their families to the campus community early and often. The conference is held during Women's History Month and has become an integral part of the EMCC Women's history month activities.

The conference's education fair provides an opportunity to get information about preparing for high school (for middle school participants) and preparing for college (for the high school participants). The education fair for the middle school participants includes a walk-through display of organizations, clubs, museums and corporations sharing information on extracurricular activities designed for exploring STEM topics. In addition, there are workshops for parents providing information on college admissions requirements, how to prepare for college, college and university application process and information on financial aid, scholarships

The fourth and the least influential source of self-efficacy is physiological arousal, where people interpret their emotional states as a reflection of their capability to accomplishing a given task or goal. People may interpret their high stress and anxiety as a reflection of their lack of ability.⁵ All Hermanas conference volunteers were briefed on the purpose of the conference goals and desire to create a positive, nurturing environment for the conference participants. A positive tone

is set throughout the conference. All participants are encouraged to explore, share and design their future. The conference starts with an energizing opening ceremony with motivational speakers, and ends with awards, recognitions, door prizes at the closing ceremony. The Conference is a day filled with information, fun, networking, experiential opportunities, exposure to community college campus, faculty and staff, and empowerment. Details of a Hermanas conference are shown below in the 2008 agenda for high school students.

Hermana's Design Your Future 2008 * Estrella Mtn. Community College – Wednesday, March 26th

Workshop Schedule HIGH SCHOOL

From	Activity	Room number
8:30 to 9:00 am	Registration	Estrella Hall Patio and Ceremonial Plaza
9:00 to 9:30 am	Breakfast / Welcome / Agenda Overview / Logistics	Montezuma North Courtyard
9:30 to 9:45 am	Welcome to EMCC - Dr. Ernie Lara	
9:45 to 10:00 am	Transition to Workshops	
10:00 am to 10:45 am	A1 Latina Townhall Panel Discussions	Plaza Gallery
	Lemon Battery This interactive session will include A2 & A3 <ul style="list-style-type: none"> • Study of electrical circuits • Using a lemon as a battery source 	MON 125 - A2 MON 143 - A3 MON 139 - <i>extra for A4)</i>
10:45am to 11:30 am	A2 & A3 Latina Townhall Panel Discussions	Plaza Gallery
	Lemon Battery This interactive session will include A1 <ul style="list-style-type: none"> • Study of electrical circuits • Using a lemon as a battery source 	MON 125
10:00 am to 11:30 am	Sustainability - Alternative Power This interactive session will include B <ul style="list-style-type: none"> • Study of solar power • Use of everyday materials to build a solar cooker 	
11:30 to 12:15 pm	Lunch with a Buddy	Student Life Lounge
12:15 to 12:35 pm	Motivational Speaker - Imelda Castro, Intel	Community Room
12:35 to 12:45 pm	Transition to Workshops	
12:45 to 1:30 pm	B1 Latina Townhall Panel Discussions	Plaza Gallery
	Lemon Battery This interactive session will include B2 & B3 <ul style="list-style-type: none"> • Study of electrical circuits • Using a lemon as a battery source 	MON 125 - B2 MON 143 - B3
1:30 pm to 2:15 pm	B2 & B3 Latina Townhall Panel Discussions	Plaza Gallery
	Lemon Battery This interactive session will include B1 <ul style="list-style-type: none"> • Study of electrical circuits • Using a lemon as a battery source 	MON 125 Go to Plaza Gallery by 2:15

Figure 1. Sample conference agenda

Hands-on activities

The hands-on activities were selected by using the general goal of creating a cooperative learning experience, fostering self-confidence, engaging participants in activities relevant to their lives and providing diverse role models. The following are recommendations taken from the National Council for Research on Women (NCRW) to improve the preparation of female students in the math, science, engineering and technology:

- Recognize and encourage learning styles and interests that evolve from the experience of girls and young women.
- Stress active and cooperative learning.
- Demonstrate to young women that technology presents powerful ways to have a highly positive impact on society.
- Encourage activities that integrates science and technology learning with other disciplines,
- Provide girls and young women with mentors from local campuses research facilities and corporations.²

These recommendations fulfill the Hermanas conference objective of creating an encouraging student-centered learning environment, contextual curriculum that emphasizes exploration and cooperative learning.

Belenky, Goldberger and Tarule in, *Women's Ways of Knowing*, noted that women tend to be connected knowers, where context is an important role and intuition, induction and creativity are a part of the learning process. A contextual curriculum is a common theme for making the science and engineering classroom more inclusive.⁷ This allows students the opportunity to connect what they are learning in the classroom to events outside the classroom. Learning is enhanced if students understand the relationship between abstract ideas and real-world applications. This can be achieved through interdisciplinary, multi-disciplinary approaches to science curricula.⁸ In the book, *They're not Dumb they're different*, Tobias proposes that capable students reject science degree programs because of their emphasis on individual competition, narrow syllabus content, lack of application, context and of opportunities for cooperative or interactive learning.¹⁷

According to research studies, the implementation of group work in the classroom creates a more equitable learning environment. It has also been shown to be a way to attract and retain women in engineering. Working in small groups has been widely accepted as a means of achieving equity, minimizing classroom competition and promoting cooperation.⁹ Ideally, teamwork provides everyone (male and female) with the opportunity to share knowledge, exchange ideas and contribute to creating a solution.¹⁰ This is especially important in the male dominated field

of engineering, where there is often a “chilly” climate for female students and faculty members.^{12, 13} Early collaborative design experiences have been promoted as another means of providing women with more positive experiences in engineering and serves as great preparation for engineering careers.¹²

The Hermanas conference committee focused on selecting activities designed to integrate science and engineering skills into the everyday experiences of the participants. The hands-on workshops were facilitated by college faculty members with assistance from corporate and college volunteers.

The table below summarizes the hands-on activities through the years of the conference. Using input from the participants and workshop facilitators, each year the activities became more focused and themed-based. For the 2008 conference the same activities were done with the middle school and high school participants. Based on their input and our observations we found the middle school participants enjoyed the same activities as the high school participants, however they were more engaged when they were with their age group. The 2008 conference was the first conference with two separate dates one for middle school participants and the other for high school participants. In previous years, the conference had been held during one day with both middle and high school participants yet offered two separate “conference tracks”. The 2008 separation of the conference allowed for two one-day conferences each focused on one level: one day for middle school and one day for high school students.

Year	Middle School	High School
2006	Balloon Flinker project Polymer Silly Slim Polymer from disposable Diaper	Barbie Bungee Rocket design and launch
2007	"The Buzz on Electricity" A bulb, wire and battery activity The structure of a light bulb-circuit How to build a Hidden Alarm Design	"Design, Build, and Make it GO!" Overview of the design process design a car powered by a rubber band
2008	"Alternative Energy Sources" Make a Lemon battery Make a Solar ovens	"Alternative Energy Sources" Make a Lemon battery Make a Solar ovens
2009	"Alternative Energy Sources" Solar ovens Build a Mousetrap car Build Life saver car powered by wind	"Alternative Energy Sources" Solar ovens Build a Mousetrap car Build Life saver car powered by wind

Table 1. Summary of hands-on activities.

Participation

The number of Hermanas conference participants varies from year to year. We have found that the day the conference is held has the biggest impact on participation. For middle school students, having the conference on a Saturday resulted in more participation. However, we found that holding the conference on a weekday, there were more high school participants.

	2005	2006	2007	2008	2009	Totals
Middle School Students	78	89	141	110	52	470
High School Students	37	26	37	180	169	449
Total	115	115	178	290	221	919

Table 2. Conference participation numbers

Survey Instrument / feedback

The conference survey and feedback is instrumental in shaping the conference and gauging student impact. The survey questions were very simple and designed to not only get feedback on how to improve the conference and meet the participants' needs, but to also get an idea of the impact the conference had on the participants' decision to go to college, or to consider a STEM major. The survey was approved through the Maricopa County Community Colleges research office to include the under 18 and protected group. The survey also served as the participants raffle ticket for door prizes during the closing ceremony. This proved to be an effective incentive for participants.

The participants answered the following five "yes" or "no" questions before the conference started and at the closing ceremony.

1. Do you know how to prepare for college?
2. Do you plan to graduate from college?
3. Do you know what an engineer does?
4. Do you think you could be an engineer or scientist?
5. Will you consider a technical career?

In the first three years of the conference (2005, 2006, 2007), the survey data shows a significant increase in the student perception of their knowledge of preparing for college from 31-37%

before the conference and increasing to 95-100% following the conference. Similar gains were made in the response to the statement, “I know what an engineer does” which found a pre-conference range of 12-37% and a post conference range of 87-100%. More moderate gains were found for the statements, “I can be an engineer / scientist” 52-61% pre and 87-96% post and “I will consider a technical career” 49-83% pre and 87-94% post. The one statement that showed almost no difference was the statement, “I plan to graduate from college.”

The following tables summarize the data taken from survey respondents that participated in the conferences:

2005 (115 respondents)	Before	After
I know how to prepare for college	31%	100%
I plan to graduate from college	98%	100%
I know what an engineer does	12%	100%
I can be an engineer / scientist	52%	89%
I will consider a technical career	49%	91%

Table 3. 2005 Participant survey summary

2006 (115 respondents)	Before	After
I know how to prepare for college	36%	95%
I plan to graduate from college	99%	99%
I know what an engineer does	24%	97%
I can be an engineer / scientist	76%	96%
I will consider a technical career	83%	94%

Table 4. 2006 Participant survey summary

2007 (178 respondents)	Before	After
I know how to prepare for college	37%	100%
I plan to graduate from college	94%	100%
I know what an engineer does	37%	87%
I can be an engineer / scientist	61%	87%
I will consider a technical career	72%	87%

Table 5. 2007 Participant survey summary

The survey instrument was updated and expanded in 2008 to include three additional questions. The 2008 and 2009 survey data showed similar gains/results. One important inclusion in this data was the statement, “I have information on how I can overcome these situations (that could stop me from reaching a college education)” which showed a pre-conference result of 47% in 2008 and 2009 and a post-conference response of 94% in 2008 and 96% in 2009. These two statements were added in 2008 to specifically ascertain if the conference was providing the “tools” or “resources” that the participants could draw upon in the future when needed.

2008 (approx 200 respondents)	Before	After
I know how to prepare for college	47%	98%
I plan to graduate from college	96%	100%
I know what an engineer does	30%	96%
I can be an engineer / scientist	50%	95%
I will consider a technical career	44%	97%
There are situations that could stop me from reaching a college education	53%	59%
I have information on how I can overcome these situations	47%	94%
I would like to obtain a college education	99%	100%

Table 6. 2008 Participant survey summary

2009 (158 respondents)	Before	After
I know how to prepare for college	70%	93%
I plan to graduate from college	97%	100%
I know what an engineer does	55%	92%
I can be an engineer / scientist	66%	93%
I will consider a technical career	65%	91%
There are situations that could stop me from reaching a college education	56%	58%
I have information on how I can overcome these situations	53%	96%
I would like to obtain a college education	100%	100%

Table 7. 2009 Participant survey summary

We are currently in the process of analyzing past participants' status and determining how many of the high school participants have gone to college and whether or not they have pursued a STEM field. Although the Hermanas Conference is a one day professional conference, the supportive environment has proven to be enough to make a difference in the lives of many young Latinas. One conference participant, a sophomore at a local high school, mirrored others' responses when she shared its effect on her. "Seeing Hispanic women who have succeeded in their careers shows me that if I try hard and keep going to school, I can achieve my goals and succeed like they did. And maybe accomplish even more." Another conference participant, also a sophomore, added, "The hands-on activities are what I liked most. I learned how to talk and work with new people and it showed me that different careers are open to me."¹

The upcoming conferences at EMCC in February and March 2010 will host more than 300 Latinas bringing the total conference attendees to 1250 for the six years. Intel has a strong desire to promote the Hermanas Conference and its successful impacts within the larger Phoenix area community. Building on the Best Practices and continuing with the Community College partnership, the Conference planning team is in negotiations with Chandler-Gilbert Community College (CGCC), a sister college in the Maricopa District, located in the East Valley. The desire is to host a one day middle school outreach for Latinas in the East Valley at CGCC campus in Fall 2010.

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